

Serial No. 09/587,074

In the Claims:

Claims 1 - 43 (previously canceled).

44. (canceled)

45. (currently amended) ~~The vertical cavity surface emitting laser of claim 44 further comprising:~~

A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror formed adjacent to said substrate;

an active region formed adjacent to said first mirror;

a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

an anti-phase layer formed on said semiconductor mirror;

an annular reflector formed on said anti-phase layer wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss in order to suppress higher order modes; and

a re-phase layer formed on said anti-phase layer and within said annular reflector.

46. (previously added) The vertical cavity surface emitting laser of claim 45 wherein a total thickness of said anti-phase layer and said re-phase layer is substantially an integer multiple of  $\frac{1}{2}$  wavelength.

47. (previously added) The vertical cavity surface emitting laser of claim 45 further comprising:

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

Serial No. 09/587,074

48. (previously added) The vertical cavity surface emitting laser of claim 46 further comprising:

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

49. (currently amended) ~~The vertical cavity surface emitting laser of claim 44~~

A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror formed adjacent to said substrate;

an active region formed adjacent to said first mirror;

a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

an anti-phase layer formed on said semiconductor mirror, wherein said anti-phase layer is formed from a semiconductor material;

an annular reflector formed on said anti-phase layer wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss in order to suppress higher order modes.

50. (previously added) The vertical cavity surface emitting laser of claim 45 wherein said anti-phase layer is formed from a semiconductor material.

51. (previously added) The vertical cavity surface emitting laser of claim 45 wherein said re-phase layer is formed from a dielectric material.

52. (canceled)

53. (canceled)

Serial No. 09/587,074

54. (currently amended) ~~The vertical cavity surface emitting laser of claim 44~~  
A vertical cavity surface emitting laser comprising:  
a substrate;  
a first mirror formed adjacent to said substrate;  
an active region formed adjacent to said first mirror;  
a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;  
an anti-phase layer formed on said semiconductor mirror, wherein said anti-phase layer is planar;  
an annular reflector formed on said anti-phase layer wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss in order to suppress higher order modes.
55. (previously added) The vertical cavity surface emitting laser of claim 45 wherein said anti-phase layer and said re-phase layer are planar.
56. (currently amended) ~~The vertical cavity surface emitting laser of claim 44 wherein~~  
A vertical cavity surface emitting laser comprising:  
a substrate;  
a first mirror formed adjacent to said substrate;  
an active region formed adjacent to said first mirror;  
a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;  
an anti-phase layer formed on said semiconductor mirror;  
an annular reflector formed on said anti-phase layer wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss in order to suppress higher order modes,  
said annular reflector comprises comprising a step function mesa formed in the surface of said anti-phase layer.

Serial No. 09/587,074

57. (canceled)

58. (currently amended) ~~The vertical cavity surface emitting laser of claim 57 further comprising:~~

A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror formed adjacent to said substrate;

an active region formed adjacent to said first mirror;

a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

an anti-phase layer formed on said semiconductor mirror;

an annular reflector formed on said anti-phase layer, said annular reflector defining an optical axis of said laser,

said anti-phase layer and said annular reflector cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis; and

a re-phase layer formed on said anti-phase layer and within said annular reflector.

59. (previously added) The vertical cavity surface emitting laser of claim 58 wherein a total thickness of said anti-phase layer and said re-phase layer is substantially an integer multiple of  $\frac{1}{2}$  wavelength.

60. (previously added) The vertical cavity surface emitting laser of claim 58 further comprising:

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

Serial No. 09/587,074

61. (previously added) The vertical cavity surface emitting laser of claim 59 further comprising:

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

62. (currently amended) ~~The vertical cavity surface emitting laser of claim 57~~

A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror formed adjacent to said substrate;

an active region formed adjacent to said first mirror;

a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

an anti-phase layer formed on said semiconductor mirror, wherein said anti-phase layer is formed from a semiconductor material;

an annular reflector formed on said anti-phase layer, said annular reflector defining an optical axis of said laser.

said anti-phase layer and said annular reflector cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis.

63. (previously added) The vertical cavity surface emitting laser of claim 58 wherein said anti-phase layer is formed from a semiconductor material.

64. (previously added) The vertical cavity surface emitting laser of claim 58 wherein said re-phase layer is formed from a dielectric material.

65. (previously added) The vertical cavity surface emitting laser of claim 62 wherein said re-phase layer is formed from a dielectric material.

Serial No. 09/587,074

66. (canceled).
67. (currently amended) ~~The vertical cavity surface emitting laser of claim 57~~  
A vertical cavity surface emitting laser comprising:  
a substrate;  
a first mirror formed adjacent to said substrate;  
an active region formed adjacent to said first mirror;  
a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;  
an anti-phase layer formed on said semiconductor mirror, wherein said anti-phase layer is planar;  
an annular reflector formed on said anti-phase layer, said annular reflector defining an optical axis of said laser,  
said anti-phase layer and said annular reflector cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis.
68. (previously added) The vertical cavity surface emitting laser of claim 58 wherein said anti-phase layer and said re-phase layer are planar.
69. (currently amended) ~~The vertical cavity surface emitting laser of claim 57 wherein~~  
A vertical cavity surface emitting laser comprising:  
a substrate;  
a first mirror formed adjacent to said substrate;  
an active region formed adjacent to said first mirror;  
a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

Serial No. 09/587,074

an anti-phase layer formed on said semiconductor mirror;

an annular reflector formed on said anti-phase layer, said annular reflector defining an optical axis of said laser,

said annular reflector ~~comprises~~ comprising a step function mesa formed in the surface of said anti-phase layer,

said anti-phase layer and said annular reflector cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis.

70. (previously added) A vertical cavity surface emitting laser comprising:

a substrate;

a first semiconductor mirror formed adjacent to said substrate;

an active region formed adjacent to said first semiconductor mirror;

a second semiconductor mirror formed adjacent to said active region, said second semiconductor mirror comprising a plurality of semiconductor mirror layers;

a planar semiconductor anti-phase layer formed on said semiconductor mirror, said anti-phase layer comprising a semiconductor mirror layer;

an annular ohmic contact formed on said anti-phase layer, said annular ohmic contact defining an optical axis of said laser and providing an annular reflective surface at a predetermined radial distance from said optical axis,

said anti-phase layer and said annular reflective surface cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflective surface are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis;

a planar dielectric re-phase layer formed on said semiconductor anti-phase layer; and

Serial No. 09/587,074

a dielectric mirror formed on said dielectric re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers, wherein said dielectric re-phase layer comprises a dielectric mirror layer and further wherein a total thickness of said anti-phase layer and said re-phase layer is substantially an integer multiple of  $\frac{1}{2}$  wavelength.

71. (previously added) A vertical cavity surface emitting laser comprising:

a substrate;

a first mirror formed adjacent to said substrate;

an active region formed adjacent to said first mirror;

a semiconductor mirror formed adjacent to said active region, said semiconductor mirror comprising a plurality of semiconductor mirror layers;

a planar anti-phase layer formed on said semiconductor mirror;

an annular reflector formed on said anti-phase layer, said annular reflector defining an optical axis of said laser,

said anti-phase layer and said annular reflector cooperating to suppress higher order modes at a predetermined radial distance from said optical axis wherein reflections from said reflector are substantially out of phase with reflections from said semiconductor mirror layers to provide mode selective optical loss at said predetermined radial distance from said optical axis, while also allowing a fundamental mode to propagate along said optical axis; and

a planar re-phase layer formed on said anti-phase layer,

wherein a planar thickness of said anti-phase layer and said re-phase layer is spatially varied with a step function at a predetermined radial distance from said optical axis to introduce a lateral index guide.

72. (previously added) The vertical cavity surface emitting laser of claim 71 wherein a total thickness of said anti-phase layer and said re-phase layer is substantially an integer multiple of  $\frac{1}{2}$  wavelength.

73. (previously added) The vertical cavity surface emitting laser of claim 71 further comprising:



Serial No. 09/587,074

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

74. (previously added) The vertical cavity surface emitting laser of claim 72 further comprising:

a dielectric mirror formed adjacent to said re-phase layer, said dielectric mirror comprising a plurality of dielectric mirror layers.

75. (previously added) The vertical cavity surface emitting laser of claim 71 wherein said anti-phase layer is formed from a semiconductor material.

76. (previously added) The vertical cavity surface emitting laser of claim 72 wherein said anti-phase layer is formed from a semiconductor material.

77. (previously added) The vertical cavity surface emitting laser of claim 72 wherein said re-phase layer is formed from a dielectric material.

78. The vertical cavity surface emitting laser of claim 76 wherein said re-phase layer is formed from a dielectric material.

79. (previously added) The vertical cavity surface emitting laser of claim 71 wherein said annular reflector comprises a conductive metallic material forming an ohmic contact.